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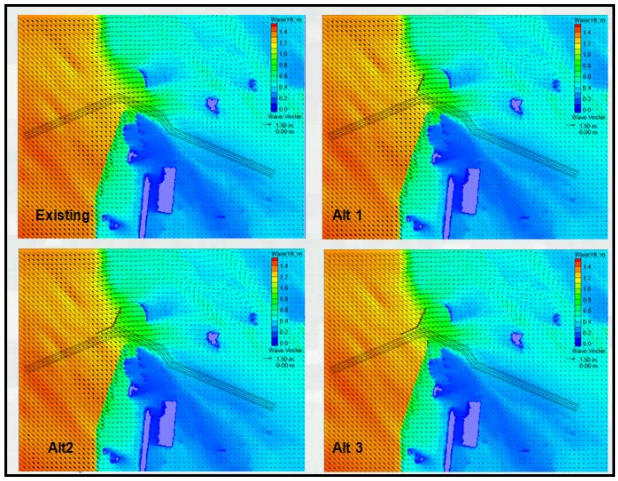
US Army Corps of Engineers®
Engineer Research and Development Center

Coastal Inlets Research Program

CMS-Wave

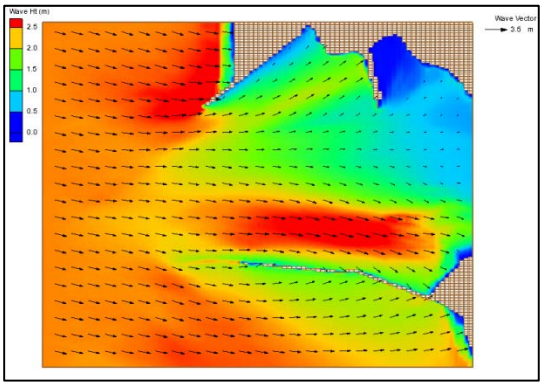
Description



Wave estimates for a navigation channel

CMS-Wave is a two-dimensional spectral wind-wave generation and transformation model that employs a forward-marching, finite-difference method to solve the wave action conservation equation. Capabilities of CMS-Wave include wave shoaling, refraction, diffraction, reflection, transmission over structures, depth-limited breaking, dissipation, wave-wave interaction, wave-current interaction, and wave-structure interaction. Wave diffraction is implemented as a diffraction term in the energy-balance equation and is derived from the parabolic wave equation. CMS-Wave can be used in either in a half- or full-plane mode, with primary waves propagating from the seaward boundary toward shore. It can calculate wave run-up, wave setup, and overtopping of structures. Shoreward and seaward reflections are treated using the mirror reflection principle. In applications to large areas, a feature of the model that facilitates nesting multiple grids may be used with two or more model grids. A larger grid with a coarse resolution may be used to simulate the regional processes while a smaller grid with fine resolution can be applied to more complex bathymetry and shoreline geometry in the local area. For large domain applications and long-term simulations, CMS-Wave can be run in a fast mode with multiple processes to expedite the model computations.

Issue Addressed


Wave estimates for a structured inlet

CMS-Wave is designed to address wave processes at coastal inlets, navigation structures, harbors and ports affecting navigation missions of USACE. The model handles wave interaction with inlet jetties and breakwaters by representing wave reflection, diffraction, transmission, and runup and overtopping for accurate estimations required for navigation safety and potential structure breaching or flanking. It may be used for wave propagation across channels and over or through structures where combined diffraction, refraction, and transmission occur simultaneously. The model may be used to evaluate wave transformation over broad shallow reefs and porous structures such as jetties. Run-up and overtopping of structures is treated in a phase-averaged engineering approach and includes the role of structural surface roughness. An approximate

analytical treatment of infra-gravity waves is included for harbor seiching and wave asymmetry applications, which also can affect sediment transport estimates.

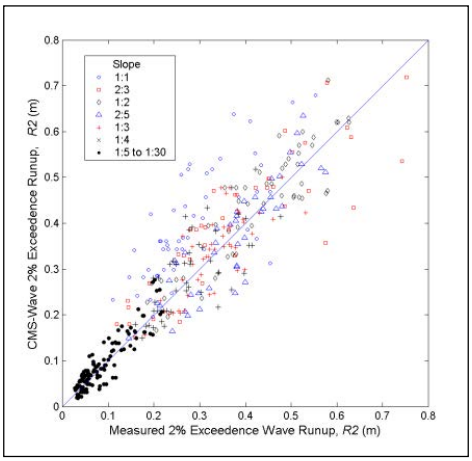
Products

CMS-Wave, a phase-averaged spectral wind-wave generation and transformation model and its interface in the Surface-water Modeling System (SMS).

Application of Products

Ambrose Entrance Channel, NY; Braddock Bay, NY; Tangier Island, VA; Norfolk, VA; Popular Island, MD; Cleveland Harbor, OH; Duluth Harbor, MN; Sand Island, WI; St. Augustine Inlet, FL; Cape Canaveral Harbor, FL; Mississippi Sound, MS; Terrebonne Bay, LA; Galveston Bay, TX; Matagorda Bay, TX; Hilo Harbor, HI; Kikiaola harbor, HI; Dana Point Harbor, CA; Pillar Point Harbor, CA; Ocean Beach, CA; Noyo Harbor, CA; Port Orford, OR; Tillamook Bay, OR; Mouth of Columbia River, OR/WA; Grays Harbor, WA; and others.

Projected Benefits



Wave run up comparison to data

CMS-Wave helps Districts to rapidly evaluate wave effects in navigation and flooding projects on regional and local scales to reduce operation and maintenance (O&M) costs. It can also be used to develop forcing conditions for local applications of the Boussinesq (BOUSS-2D) wave model that provides more rigorous calculations for design and performance optimization of integrated navigation systems. Together these wave models provide reliable predictions on regional and local spatial domains and cost-effective engineering solutions to reduce life-cycle risk levels in coastal design practice. For these reasons, these models are used together in design and realignment of channels to improve safety of navigation, infrastructure modifications at ports, harbors and marinas, rehabilitation of jetties, breakwaters, impacts of channel deepening, and for quantifying potential effects of dredge material displacement sites on adjacent channels, shorelines, wetlands, and sensitive food chain resources.

Documentation

Model documentation includes a technical report and a series of technical notes describing model theory, numerics, examples, and step-by-step user's guidance on model interface and example applications. More than a dozen journal and conference papers provide additional information about CMS-Wave capabilities in practical applications and research. Publications can be found on the CIRP website, and in open literature.

Points of Contact

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CIRP Website

- Please see the CIRP website to download documentation: http://www.erdc.usace.army.mil/Missions/WaterResources/CIRP/Publications.aspx
- View archived webinars: http://www.erdc.usace.army.mil/Missions/WaterResources/CIRP/TechTransfer.aspx
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